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A Kitchen Disinfectant.

F. A. PATTY and L. E. SAYRE.

During the period of the invasion of influenza every possible source of and every possible means for spreading contagion were sought for and checked by the Board of Health. One of the suspected possible sources of communicating the contagion was that of soda-water tumblers. Many dispensers of soda water employed paper tumblers; others installed running water at scalding temperature; others used steam; and still others employed an adequate sterilizing apparatus at considerable expense. But the majority of stores, whose business, in small towns, was comparatively small, and for other reasons were unable to adopt either method. Accordingly, the Board of Health requested the department of pharmacy to devise a sterilizing bath that would accomplish the purpose at a minimum of expense, so that it would be within the reach of every retailer. It was suggested by one of us that a sodium hypochlorite solution bath would be quite sufficient for the purpose of cleansing and disinfection, but this was merely a statement. In order to verify such

a result it was necessary to take up the subject in a scientific way and perform experiments with solutions and note their effect upon tumblers that were intentionally infected.

Laboratory experiments to cover the situation were accordingly designed and carried out. This was accomplished by first procuring cultures of three organisms. One was a culture of *Micrococcus aureus,* an organism which produces boils and abscesses and is found abundantly in the mouth and throat. It is relatively easy to kill. Another was a culture of typhoid bacillus, the bacteria causing typhoid fever. Last was a culture of *Streptococcus pyogenes,* which causes sore throat and various skin eruptions. This organism is very resistant and difficult to kill with ordinary disinfectants.

Broth cultures of these organisms were prepared and incubated twenty-four hours at body heat to obtain a luxuriant growth, then poured into glasses, previously sterilized in an autoclave. The glasses were drained, one at a time, dipped into a disinfectant bath and removed immediately. Each glass was next rinsed with sterile broth and a portion of the broth streaked on agar and incubated at body temperature to ascertain whether or not the organism had been killed by the disinfectant bath.

The time element in this way is reduced to a minimum, but so would it be in actual practice. Many solutions can be prepared which will be good disinfectants if allowed to remain in contact for some time and at a temperature somewhat above room temperature (72° F.).

An extract from the tabulation of experiments with various solutions, together with results obtained, is herewith subjoined. It may be of interest to note here that results obtained from some solutions were somewhat surprising, as will be indicated.

The calcium hypochlorite solution employed was made by triturating bleaching powder with water and straining the mixture. The sodium hypochlorite solution used is best made as directed in making solution No. 1.

FORMULA.

Solution No. 1. Triturate 200 grams bleaching powder to a smooth paste, using 400 cc. water, and wash into 2-liter flask with 200 cc. water. Add 140 grams pure sodium carbonate dissolved in 250 cc. hot water. Shake thoroughly; if contents become gelatinous, warm. Transfer to a wetted muslin strainer in a funnel and return first portion of filtrate until it comes through clear. Drain and wash with small successive portions of water to make 1,000 grams of the solution.

Use 10 cc. of solution No. 1 to make 1 liter disinfectant bath.

Solution No. 2. Measure exactly 69 cc. c.p. hydrochloric acid (sp. gr. 1.17) into a liter flask and make up to a liter with distilled water.

Use 10 cc. to each liter disinfectant bath in final preparation for use.

Precautions. All weights and measurements must be made *exact* for maximum results. Distilled water must be used in making solutions 1 and 2, and preferably, but not necessarily, in making the final bath. The bleaching powder must have at least 30 per cent available chlorine present. The most favorable temperature for the bath is between 80° and 95° F. (27° and 35° C.). Solutions 1 and 2 keep indefinitely in glass-stoppered containers.

The method of application is simply to dip the previously washed glass

into the bath, allowing all parts to come in contact with the liquid, and sterilization is complete. The bath is harmless to the hands.

It must be generally understood that no disinfectant, no matter how efficient, can so readily disinfect a dry, dirty glass. The particles of dirt (organic matter) envelop the organisms and form a protective coating. To illustrate the truth of this statement, glasses infected by a broth culture of *Streptococcus pyogenes* were allowed to dry spontaneously, then dipped twice in quick succession into bath 18, and when streaked on agar the organisms were found to be alive. Therefore, after use at fountain, glasses must not be permitted to become dry, but should be preferably rinsed in tap water before going into the bath. This precaution would also help to maintain the efficiency for a longer period than otherwise would be possible. Care must be taken not to increase alkalinity by careless addition of wash water. Glasses are to be rinsed with clean water after the disinfecting bath.

Our report to the board tabulated a long list of solutions of various compositions and the constitution of the baths made therefrom. It is not essential that this paper shall be burdened by this lengthy tabulation, but the essential points may be condensed. It was found that the maximum disinfectant power was to exist between six different solutions, as follows:

Disinfectant Bath.	Organism.	Killed.		Growth inhibited.
		Fresh bath.	Bath 24 hours old.	
Exp. 14: Sodium hypochlorite solution. 0.04 per cent available chlorine nearly. Neutralized with hydrochloric acid	Micrococcus aureus	–	–	+
	Typhoid bacillus	+	–	+
	Streptococcus pyogenes	–	–	–
Exp. 15: Sodium hypochlorite solution. 0.05 per cent available chlorine	Micrococcus aureus	–	–	–
	Typhoid bacillus	–	–	+
	Streptococcus pyogenes	–	–	–
Exp. 16: Sodium hypochlorite solution. 0.1 per cent available chlorine.	Results same as for 15.			
Exp. 17: Sodium hypochlorite solution. 0.05 per cent available chlorine + 50 cc. N_{10} HCl per liter	Micrococcus aureus	+	+	+
	Typhoid bacillus	+	+	+
	Streptococcus pyogenes	–	–	+
Exp. 18: Sodium hypochlorite solution. 0.05 per cent available chlorine + 80 cc. N_{10} HCl per liter	Micrococcus aureus	+	+	+
	Typhoid bacillus	+	+	+
	Streptococcus pyogenes	+	+	+
Exp. 19: Sodium hypochlorite solution. 0.05 per cent available chlorine + 120 cc. N_{10} HCl per liter	Micrococcus aureus	+	–	+
	Typhoid bacillus	+	+	+
	Streptococcus pyogenes	+	–	+

It should be stated, in passing, that hot water was found to be not at all satisfactory unless considerable time be allowed for the glass to macerate therein.

A simple solution of sodium hypochlorite, rather unexpectedly, was not efficient.

In an effort to produce a sodium-hypochlorite solution less alkaline, and consequently more efficient, solution No. 1 was made up by four different

formulas, using less sodium carbonate, and baths of 0.05 per cent available chlorine made from them, but all proved unsatisfactory.

Bath No. 18 was repeated with the same good results, and was found to be germicidal to micrococcus aureus and typhoid bacillus, even after standing seven days. A liter was then tried on 150 glasses in a series and found to be efficient for that number. Although this bath under good conditions is germicidal more than twenty-four hours, it is strongly recommended that it be prepared fresh each day.

It may be noted in the experimental data that the hot water is not at all efficient in the time allowed. By comparing the results it can be seen that a 0.06 per cent available chlorine solution is of little more value than a 0.04 per cent solution. A strong alkaline solution appears to be as good the second day as the first and to be as powerful as a neutral solution. The sodium carbonate tends to hold the chlorine in solution. A solution made acid with hydrochloric acid is strongly germicidal when freshly prepared, but of no value after standing twenty-four hours, because the chlorine is liberated and soon escapes from the solution. Sodium salicylate, germicidal in itself, appears to add no power to the hypochlorite solutions.

The unneutralized sodium hypochlorite solution proved to be of no value even in a strong (0.1) available chlorine bath. This was a revelation very disappointing, to say the least. The idea of reducing the alkalinity suggested itself. Therefore, varying amounts of N/10 hydrochloric acid, sufficient to neutralize the solution, were added to baths 17, 18 and 19. The results were somewhat striking, in that it was found that the maximum results were obtained, as will be seen, in the mean between 17 and 19; namely, in 18.

CONCLUSIONS.

1. It will be seen from our report to the State Board of Health that nineteen different solutions of various compositions were experimented with. The solutions containing available chlorine were the only ones that were available for making a disinfectant bath. Of the various sodium hypochlorite baths tested it was found that the amount of free chlorine was not the only factor that determined efficiency. For example, a bath containing 0.1 per cent of available chlorine was no more efficient than one containing .04 per cent or .05 per cent.

2. The efficiency of the hypochlorite bath seems to depend not only upon the available chlorine, but also upon the degree of alkalinity of the solution. The most efficient solution seems to be that containing .05 per cent of available chlorine and a degree of alkalinity represented by almost the neutral point. In order to determine the exact amount of alkalinity, an aliquot portion of the solution neutralized with its equivalent of HCl (the amount designated in formula 18) was evaporated to dryness, the residue redissolved in distilled water, and the resulting solution titrated. It was found that 1 cc. of the original solution thus prepared corresponded to 5.0 cc. of N/10 HCl. Since 10 cc. are used in a liter of bath, the alkalinity of this would make a liter of the bath correspond to 50 cc. N/10 HCl.

3. This solution of the above alkalinity can be arrived at by using the proportions indicated in formula 18, using the solutions and mixing same as prescribed in said formula.

4. Since one of the microörganisms resisted the boiling-water bath and only two were inhibited in growth, therefore it would seem that any treatment with boiling water—much less warm water—would be absolutely unreliable unless care was taken that the utensil was permitted to remain in such a bath for some minutes. It is also suggested that the wiping of the cleansed tumbler with a fabric would be objectionable, for the reason that repeated use of same would tend toward a risk of contamination.

5. There are a number of proprietary disinfectants on the market containing available chlorine. Some of these are valuable, but their value should be estimated by the percentage of available chlorine present, but only by a coefficient biologically determined.

KITCHEN DISINFECTANT.

The above solution, it is needless to say, would be a very valuable solution as a household disinfectant, or, as we have chosen to term it, a kitchen disinfectant. It is a deodorant as well.

Besides being applicable for disinfection and purification, it may be employed as a bleach in the wash water, and is not injurious to the fabric.

It should be stated that the formula for the preparation of this disinfectant is, perhaps, rather intricate and beyond the ability of the unskilled to follow. The formula, however, can be readily followed by one of very ordinary ability in manipulation, so that its manufacture would not be at all expensive.

[NOTE.—Plant Disease Survey Report for Kansas, 1919, by L. E. Melchers, withdrawn.]